

**NHDPlusV2 VAA Navigator
User Documentation
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Contents

Description	1
NHDPlusV2 Navigator Toolbar	1
SQL Server 2012 LocalDB and the NHDPlusV2 VAA Navigator	2
Installation	2
Using the NHDPlusV2Navigator from a User-written Program	3
Known Problems & Issues.....	9

Description

The NHDPlusV2Navigator performs navigation on the NHDPlusV2 surface water network using NHDPlusV2 Value Added Attributes (PlusFlowlineVAA.dbf). The Navigator may be used through ArcMap via a special ArcMap toolbar or it may be called from user-written program code. The Navigator will work on any NHDPlusV2 workspace and requires the NHDSnapshot and NHDPlusAttributes components to be installed for each VPU on which the Navigator will be used.

The Navigator performs four types of navigation: upstream mainstem, upstream with tributaries, downstream mainstem, and downstream with divergences. Navigations can begin and end on full NHDFlowline features or may begin and end as points along features.

Any of the four types of navigation may be stopped based on a user-supplied distance from the starting point. Navigation results may also be filtered based on certain user specified criteria.

NHDPlusV2 Navigator Toolbar

From the ArcMap toolbar, the first time the VAA Navigator is executed for a given NHDPlusV2 VPU, it builds a database for that VPU that speeds up future navigations. The database is called V02NavDB_<vvvvvvvv>.mdf, where <vvvvvvvv> is the VPUid for the NHDFlowline feature class being navigated. The database is created in a local folder specified by the user. The second and subsequent times that the Navigator is

executed, it looks for the database and, if found, uses it. If the database has been deleted, a new database is created.

Recommendation: In the navigation options dialog displayed when the VAA Navigator Toolbar is used, specify that the Navigator databases are to be stored with your installed NHDPlusV2 data in a folder that you create for that purpose.

Note: While the NHDPlusV2 VAA Navigator is capable of navigating drainage areas that contain multiple VPUs, when used through the ArcMap toolbar, only a single VPU will be navigated during each use of the tool.

SQL Server 2012 LocalDB and the NHDPlusV2 VAA Navigator

The Navigator uses SQL Server 2012 Express LocalDB to build the navigation databases described above. SQL Server 2012 Express LocalDB must be installed on the computer that is going to run the Navigator. The SQL Server instance must be accessible to the login of the user who will be executing the Navigator. If SQL Server is installed with default parameters, then the default server instance name is *(localdb)\V11.0*.

Once a navigation database is created by the VAA Navigator, it MUST only be deleted or moved through the SQL Server functions found in SQL Server 2012 Management Studio. The databases should never be renamed.

Installation

Install or upgrade Microsoft .NET (see NHDPlusV2 VAA Navigator Toolbar “System Requirements” on the NHDPlusV2 Tools webpage). Links to the Microsoft web page for .NET are also on the tools webpage.

Install SQL Server 2012 Express LocalDB and SQL Server 2012 Management Studio. Install packages are available on the NHDPlusV2 Tools webpage

The NHDPlusV2 VAA Navigator is installed as part of the installation of the NHDPlusV2 VAA Navigator Toolbar. If you have a previous version of the NHDPlusV2 VAA Navigator Toolbar installed, remove the toolbar from the ArcMap toolbar ribbons and uninstall the NHDPlusV2 VAA Navigator using Windows Control Panel.

Create a directory on your hard drive to use for the installation. Place a copy of NHDPlusV2VAANavigatorToolbar_<version number>.7z file into that directory. Use 7-Zip to unzip NHDPlusV2VAANavigatorToolbar_<version number>.7z using the “Extract Here” option. Once the installation is complete, this directory and its contents may be removed, if desired.

Double-click on NHDPlusV2VAANavigatorToolbarSetup.exe to start the installation program. The installation program will place all the necessary files on your local hard drive and add the necessary entries to your computer's registry. During the installation, you will need to select a location on your hard drive to be used for NHDPlus Tools. This will default to C:\NHDPlusTools in the install process. You may change the default to a <drive>:\<foldername> of your choice. The folder may already exist, but that is not required. It is recommended that all NHDPlusV2 tools be installed in the same folder. The NHDPlusV2 VAA Navigator Toolbar (and the NHDPlusV2 VAA Navigator) will be placed in a sub-folder called NHDPlusV2VAANavToolbar under the folder specified during the install.

To register the NHDPlusV2 VAA Navigator Toolbar with ArcMap:

1. Start ArcMap. If using Windows 7 or a later version of Windows, you may need to right click on ArcMap and choose "Run As Administrator".
2. Right click on an empty area of the ArcMap toolbar ribbons. Select "Customize" (at the bottom of the list). Choose the "Commands" tab in the Customize dialog.
3. Click "Add from File". Navigate to the folder where you installed the VAA Navigator. Select NHDPlusV2VAANavToolbar\NHDPlusV2VAANavToolbar.tlb. Click OK. If you receive a "No Objects Added" message, then you must return to step 1 and use the "Run As Administrator" option.
4. Click "Close"
5. Right click on an empty area on the ArcMap toolbar ribbons. Select the NHDPlusV2 VAA Nav Toolbar from the list.

Using the NHDPlusV2Navigator from a User-written Program

The NHDPlusV2 VAA Navigator is designed to operate on drainage areas consisting of one or more VPUs. The Navigator consists of three parts (classes or modules):

LoadSqlServerDB – Loads PlusFlowlineVAA, PlusFlow, and MegaDiv data for a single VPU into the working SQL Server database. This module can be called multiple times for drainage areas containing multiple VPUs.

MakeWorkingTable – Creates a working table to be used for a single navigation from the data previously loaded into the database via LoadSqlServerDB. The working table is named t<sessionid>_vaa, where <sessionid> is a value generated by the user's program using system date and time in the format of yyymmddhhmmss. Using a unique sessionid enables the Navigator to be called concurrently by multiple user programs.

V02Navigator1 – Performs a navigation and places the results in a SQL Server table named t<sessionid>_navresults.

Properties:

The properties in **RED** are required by the Navigator.

TempWorkAreaPath – input property

Type: String

Applies to calls to: LoadSqlServerDB, MakeWorkingTable

Value: Path to a temporary work area

DataSource – input property

Type: String

Applies to calls to: LoadSqlServerDB, MakeWorkingTable, V02Navigator1

Value: Name of the SQL Server datasource on your local computer. Example:

Datasource="(LocalDB)\v11.0"

AddToExisting – input property

Type: Boolean

Applies to calls to: LoadSqlServerDB

Value:

False - for the first VPU

True - otherwise

DatabaseLocation – input property

Type: String

Applies to calls to: LoadSqlServerDB, MakeWorkingTable, V02Navigator1

Value: Path to the navigation SQL Server database

DatabaseName – input property

Type: String

Applies to calls to: LoadSqlServerDB, MakeWorkingTable, V02Navigator1

Value: Name for the navigation SQL Server database

Recommendation: Use a drainageID (DD) or a VPUid (VVVVVVVV) in the name, as appropriate.

InputNHDPlusLocation – input property

Type: String

Applies to calls to: LoadSqlServerDB

Value: Upper level VPU folder location (i.e. this folder will be named NHDPlus<vpuid>)

SessionID – input property

Type: String

Applies to calls to: MakeWorkingTable, V02Navigator1

Value: SessionID for the navigation, unique value based on the computer system date and time allowing multiple concurrent calls to the Navigator

WorkingTableName – output/input property

Type: String

Applies to calls to: MakeWorkingTable (output), V02Navigator1 (input)

Value: Table name (of the form t<sessionid>_VAA) for the working table that holds the VPU data

Navtype – input property

Type: String

Applies to calls to: V02Navigator1

Value: UPMAIN or UPTRIB or DNMAIN or DNDIV

StartComid – input property

Type: Numeric

Applies to calls to: V02Navigator1

Value: Starting NHDFlowline Comid for the navigation, must be greater than 0

StartMeasure – input property

Type: Numeric

Applies to calls to: V02Navigator1

Value: Starting measure for the navigation, must be between 0 and 100 inclusive or -1

For -1, the Navigator starts at the “from” measure (i.e. bottom) of the NHDFlowline feature for upstream navigations and at the “to” measure (i.e. top) of the NHDFlowline feature for downstream navigations.

MaxDistance – input property

Type: Numeric

Applies to calls to: V02Navigator1

Value: Maximum travel distance in kilometers, greater than or equal to 0

A value of 0 indicates there is no maximum travel distance and that the Navigator is to navigate each path until the path ends. 0 is the default value.

ReturnValue –

Type: Integer

Applies to calls to: LoadSqlServerDB, MakeWorkingTable, V02Navigator1

Value: Return value of a process. 0 for success, 1 otherwise.

ProcessStatus – output property

Type: Integer

Applies to calls to: LoadSqlServerDB, MakeWorkingTable, V02Navigator1

Value:

900 - runtime exception

0 - successful completion

ProcessMessage – output property

Type: String

Applies to calls to: LoadSqlServerDB, MakeWorkingTable, V02Navigator1

Value: For unsuccessful completions, there is a message about the problem that was encountered.

Methods:

LoadSQLServerDB –

Applies to calls to: LoadSQLServerDB

Function: Loads \NHDPlusAttributes\PlusFlowlinevaa, PlusFlow and MegaDiv for a VPU into the working database.

MakeWorkingTable –

Applies to calls to: MakeWorkingTable

Function: Creates the working table to be used for a navigation from the VPU data loaded into the working database.

VAANavigate –

Applies to calls to V02Navigator1:

Function: Performs a navigation. Returns 1 if there is a known problem, 0 otherwise.

Results of the navigation are placed in t<sessionid>_NavResults in the working SQLServer database.

VB.NET Example:

Add NHDPlusV2Navigator as a project reference.

```
'Declarations
Dim objLoadDB As NHDPlusV2Navigator.clsLoadSqlServerDB
Dim objMakeWorking As NHDPlusV2Navigator.clsMakeWorkingTable
Dim objNavigate As NHDPlusV2Navigator.clsV02Navigator1
Dim intReturn as integer

'Call LoadDB for all VPUS in the DrainageArea. Put this code section
in a 'loop and set AddToExisting property equal to true for everything
except the 'first VPU.

'Set properties
objLoadDB = New NHDPlusV2Navigator.clsLoadSqlServerDB
objLoadDB.DataSource = "(LocalDB)\v11.0"
objLoadDB.DatabaseLocation = "c:\NHDPlusV2\NHDPlusDD"
objLoadDB.DatabaseName = "V02NavDB_DD"
objLoadDB.TempWorkAreaPath = "c:\NHDPlusV2\Working"

'Loop this code block for each VPU. Note: The NHDPlusV2 VAA Nav
Toolbar ' always operates only on one VPU.
'Begin Loop
objLoadDB.AddToExisting = True 'then false
objLoadDB.InputNHDPlusLocation = "c:\NHDPlusV2\NHDPlusDD\VPU01"
```

```

'Call the method to load the data
intReturn = objLoadDB.LoadSQLServerDB()
If intReturn <> 0 Then
    strReturn = "Return Value: " + intReturn.ToString + vbCrLf + _
        "ProcessStatus: " + objLoadDB.ProcessStatus.ToString + vbCrLf + _
        "ProcessMessage: " + objLoadDB.ProcessMessage
    Exit Try
End If
'End Loop

'For each navigation, call MakeWorking followed by Navigate.

'MakeWorking'
objMakeWorking = New NHDPlusV02Navigator.clsMakeWorkingTable
objMakeWorking.DataSource = "(LocalDB)\v11.0"
objMakeWorking.DatabaseLocation = "c:\NHDPlusV2\NHDPlusDD"
objMakeWorking.DatabaseName = "V02NavDB_DD"
objMakeWorking.TempWorkAreaPath = "c:\NHDPlusV2\Working"
objMakeWorking.SessionID = "DD"
objMakeWorking.AttrName = ""
objMakeWorking.StartComid = 1111111
objMakeWorking.navtype = "UPTRIB"
intReturn = objMakeWorking.MakeWorkingTable()
If intReturn > 0 Then
    strReturn = "Return Value: " + intReturn.ToString + vbCrLf + _
        "ProcessStatus: " + objMakeWorking.ProcessStatus.ToString + vbCrLf + _
        "ProcessMessage: " + objMakeWorking.ProcessMessage
        "Working Table Name: " + objMakeWorking.WorkingTableName
    Exit Try
End If

'Navigate
objNavigate = New NHDPlusV2Navigator.clsV02Navigator1
objNavigate.DataSource = "(LocalDB)\v11.0"
objNavigate.DatabaseLocation = "c:\NHDPlusV2\NHDPlusDD"
objNavigate.DatabaseName = "V02NavDB_DD"
objNavigate.SessionID = "DD"
objNavigate.WorkingTableName =objMakeWorking.WorkingTableName
objNavigate.StartComid = 1111111
objNavigate.StartMeasure = -1
objNavigate.NavType = "UPTRIB"
objNavigate.MaxDistance = 0
intReturn = objNavigate.VAANavigate()
if intReturn <> 0 then
    strReturn = "Return Value: " + intReturn.ToString + vbCrLf + _
        "ProcessStatus: " + objNavigate.ProcessStatus.ToString + vbCrLf + _
        "ProcessMessage: " + objNavigate.ProcessMessage
End if

```

Python Example:

The following Python script performs navigation using the NHDPlusV2Navigator. Lines beginning with # are comments. The print statements are for debugging purposes only.

```
import win32com.client

#Initialize objects
o1 = win32com.client.Dispatch("NHDPlusV2Navigator.clsLoadSQLServerDB")
o2 = win32com.client.Dispatch("NHDPlusV2Navigator.clsMakeWorkingTable")
o3 = win32com.client.Dispatch("NHDPlusV2Navigator.clsV02Navigator1")

#Call LoadSqlServerDB
#Set common properties
o1.DataSource = "(LocalDB)\v11.0"
o1.DatabaseLocation = "C:\\Working\\NHDPlusDataV2\\HUCS\\NHDPlus02"
o1.DatabaseName = "V02NavDB_02"
o1.TempWorkAreaPath = "C:\\Working\\NHDPlusDataV2\\Working"

#Loop this code block for each VPU. Note: The NHDPlus V2 VAA Nav Toolbar
#always operates only on one VPU.
#Begin Loop
o1.AddToExisting = False
o1.InputNHDPlusLocation = "C:\\Working\\NHDPlusDataV2\\HUCS\\NHDPlus02"
#Call the method to load the data for the VPU
intReturn = o1.LoadSQLServerDB
print "LoadSQLServerDB Return Value: " + str(intReturn)
if intReturn > 0:
    print "Return Value: " + str(intReturn)
    print "ProcessStatus: " + str(o1.ProcessStatus)
    print "ProcessMessage: " + o1.ProcessMessage
#end loop - Do LoadSQLServerDB for all VPUs in DA

#For each navigation, call MakeWorking followed by Navigate

#MakeWorking
o2.DataSource = "(LocalDB)\v11.0"
o2.DatabaseLocation = "C:\\Working\\NHDPlusDataV2\\HUCS\\NHDPlus02"
o2.DatabaseName = "V02NavDB_02"
o2.TempWorkAreaPath = "C:\\Working\\NHDPlusDataV2\\Working"
o2.SessionID = "2011092111713"
o2.AttrName = ""
o2.StartComid = 11111111
o2.navtype = "UPTRIB"
intReturn = o2.MakeWorkingTable
print "MakeWorkingTable Return Value: " + str(intReturn)
print "Working Table Name: " + o2.WorkingTableName
if intReturn > 0:
    print "Return Value: " + str(intReturn)
    print "ProcessStatus: " + str(o2.ProcessStatus)
    print "ProcessMessage: " + o2.ProcessMessage

#Navigate
o3.DataSource = "(LocalDB)\v11.0"
o3.DatabaseLocation = "C:\\Working\\NHDPlusDataV2\\HUCS\\NHDPlus02"
```

```
o3.DatabaseName = "V02NavDB_02"
o3.SessionID = "2011092111713"
o3.WorkingTableName =o2.WorkingTableName
o3.StartComid = 8478572
o3.StartMeasure = -1
o3.NavType = "UPTRIB"
o3.MaxDistance = 0
intReturn = o3.VAANavigate
if intReturn > 0:
    print "Return Value: " + str(intReturn)
    print "ProcessStatus: " + str(o3.ProcessStatus)
    print "ProcessMessage: " + o3.ProcessMessage
else:
    print "Navigation completed successfully. Results are in your SQL Server
database."

#Terminate the objects
o1 = None
o2 = None
o3 = None
```

Known Problems & Issues

None.

Please contact nhdplus@hscnet.com if you experience problems with the VAA Navigator.